BEHAVIOUR OF REINFORCED CONCRETE BEAMS WITH OPENING ADDED WITH KENAF FIBER

NAZMIN BINTI ZULAILI

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I/We* hereby declare that I/We* have checked this thesis/project* and in my/our* opinion, this thesis/project* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

_____

(Supervisor's Signature)

Full Name : SHARIFAH MASZURA SYED MOHSIN

Position :

Date :

_____

(Co-supervisor's Signature)

Full Name :

Position :

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : NAZMIN BINTI ZULAILI

ID Number : AA14196

Date : June 2018

BEHAVIOUR OF REINFORCED CONCRETE BEAMS WITH OPENING ADDED WITH KENAF FIBER

NAZMIN BINTI ZULAILI

Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JUNE 2018

ACKNOWLEDGEMENTS

I would like take this opportunity to express my profound gratitude and deep regards to my faculty supervisor Dr. Sharifah Maszura Syed Mohsin for his exemplary guidance, monitoring throughout this project as a Supervisor. The blessing, help and guidance given by his time to time shall carry me a long way in the journey of degree life on which I am about to embark. I also take this opportunity to express a deep sense of gratitude to my teammates for their cordial support, valuable information and guidance, which helped me in completing this study through various stages. I am obliged to staff of the Concrete Laboratory for the valuable information provided by them in their respective fields. I am grateful for their cooperation during the period of my assignment. Lastly, I thank almighty, my family and friends for their constant encouragement without which this industrial training would not be possible.

ABSTRAK

Kajian ini membentangkan tentang penemuan program penyelidikan eksperimen yang dilakukan untuk meningkatkan tingkah laku struktur konkrit bertetulang gentian bertetulang (FRC) serat semulajadi dengan membuat pembukaan di hujung struktur konkrit yang dibuat dengan menggunakan serat kenaf. Perkadaran campuran yang sesuai dan prosedur pencampuran dikira untuk menghasilkan balok dengan pecahan jumlah kenaf, Vf dari 0%, 1% dan 2%. Kekuatan mampatan, kekuatan lenturan spesimen konkrit bertetulang serat kenaf (KFRC) dibentangkan dan dibandingkan dengan tingkah laku spesimen kawalan konkrit biasa. Keputusan eksperimen menunjukkan bahawa kelakuan KFRC dan ujian pemampatan kedua-duanya berkurangan dengan peningkatan pecahan pecahan.

ABSTRACT

This paper presents the findings of an experimental research program that was conducted to improve the structural behaviour of natural fiber reinforced concrete (FRC) beam with opening at end which is made using kenaf fiber. Appropriate mixture proportions and mixing procedures are calculated to produce beam with kenaf volume fractions, Vf of 0%, 1% and 2%. The compressive strength, flexural strength of kenaf fiber reinforced concrete (KFRC) specimens are presented and compared to the behaviour of plain concrete control specimens. The experimental results indicate that the behaviour of KFRC and compression test were both decreasing with increasing volume of fraction.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

KFRC	Kenaf Fibre Reinforced Concrete

CHAPTER 1

INTRODUCTION

1.1 Background

Natural fiber is widely used in the construction field as the strengthening material. There are few types of fiber can be used as the composites materials in concrete mixing. Few study of kenaf fibre has proven that kenaf fibre is capable to enhance the load carrying capacity (Ezekiel Babatunde et al., 2015),(Azrizal, 2015),(Mohsin et al., 2016). This study added kenaf fiber in the mixture to study the behaviour of beam with opening at end. It is proved that kenaf fiber exhibits higher strength values in terms of tensile and flexural properties, as compared to other natural fibers (Nishino et al., 2003). Furthermore, a finding suggest that fibres also have the potential to serve as part of shear reinforcement in reinforced concrete structures and is allowed for a reduction of the shear reinforcement while maintaining the ductility ratio, load-carrying capacity as well as controlling the crack propagation (Mohsin, 2012).

Opening in beams has become necessity in construction to provide lines and facilitates passage for electrical lines, water pipes, telecommunication cables with the purpose of a more systematic layout (Mondal, 2011). The shape and size can be various depends on its requirement of using and the behaviour of the beam. Previously, Manoharan and Tripathi (2017) has studied the analysis of circular opening and it is concluded that as the depth of opening increases, stress concentrations increases at the opening boundaries. The opening provided is of circular shape was very effective, it shows less stress concentrations at the web openings and will be easy to fabricate. However, in a research by (Osman et al,. 2017), he reported that shear behaviour of reinforced concrete (RC) beams with circular web openings without additional shear reinforcement beam start to fail mainly by brittle shear failure in which the diagonal shear cracks that formed at the top and bottom chords of the beams led to concrete shear failure.

In some cases, the height of a building floor is limited and has sufficient space to fit all the essential services because of the size of the beam. This design has been practically used since many years before however the presence of the opening beams, it is believed that it also leads to some problem in terms of cracking, excessive bending and decreasing in strength. In 2013, Alsaeq (2013) made a research on how web openings would impact the effective width of beams. It is concluded that web openings influence the effective width of composite beams. Structural analysis of a failures RC beam with openings in a building under construction is conducted and the analysis implies that defectively constructed openings have an impact on the behaviour of load-bearing elements (Zdanowicz and Wojdak, 2013).

Figure 1.1 Multiple opening in a beam

Figure 1.2 Cracking at the bottom of the beam near the opening.
(Source: Łukasz Zdanowicz, 2013)

There are failures of opening beams happened in the past cases for example brittle fracture caused from insufficient reinforcement, fragile fracture caused by corner cracking and crisp failure from insufficient strength of concrete. The beam most likely to fail at the location of the opening and the moment-shear interaction of the tested steel reinforced concrete beams with opening did not agree to the interaction proposed for the structural steel with opening (Chen, Li and Kuo, 2008). However, in study of analysis of steel beams with circular opening reported that analytical results for beams with circular opening show that there is no much variation in the deflection values when compared with solid beam results for all the cases considered (Manoharan et al., 2017).

1.2 Problem Statement

Beam with opening is essential to the construction these days to some of relevant purposes. However, the effect of making opening in beam is unpredictable. The hollow part of the beam may affect the changes in strength and later can cause to structural failure. Therefore, to study the strength, mix design is design by adding with different percentage of kenaf fiber.

The location of the beams also has to be taken into consideration where the failure might happen due to loading transferred. The presence of an opening itself will reduced the load carrying capacity and the stiffness of the beam. One opening at an end of the beam and compare with the one without the opening.

1.3 Objective of the Study

The strength of the beam with opening will be improved by using kenaf fiber as the additional reinforcement, the study will include few related objectives that will help in achieving the aims or the main purpose of the investigation are as below;

i. To improve performance of RC beam contains of different percentage of kenaf fiber.
ii. To study the behaviour of three RC beam with opening and RC beam without opening as the control beam.

REFERENCES

Akil, H. M. *et al.* (2011) 'Kenaf fiber reinforced composites: A review', *Materials and Design*. Elsevier Ltd, 32(8–9), pp. 4107–4121. doi: 10.1016/j.matdes.2011.04.008.

Al-sheikh, S. A. (2014) 'Flexural behaviour of RC beams with opening', *Concrete Research Letters*, 5(2), pp. 812–824.

Ali, N. M. *et al.* (2010) 'Efficiency of Internal Strengthening R . C Beams With Rectangular Openings in Shear Zone By Using Steel Plates', 38(4), pp. 929–947.

Alsaeq, H. M. (2013) 'Effects of Opening Shape and Location on the Structural Strength of R . C . Deep Beams with Openings', 7(6), pp. 1365–1370.

B.H., S. *et al.* (2014) 'Effects of Coconut Fibers on the Properties of Concrete', *Internation Journal of Research in Engineering and Technology*, 3(12), pp. 5–11. Available at: http://linkinghub.elsevier.com/retrieve/pii/S095006181631697X.

Coutts, R. S. P. (1990) 'Banana fibres as reinforcement for building products', *Journal of Materials Science Letters*, 9(10), pp. 1235–1236. doi: 10.1007/BF00721904.

Diggikar, R., Mangalagi, S. and Harsoor, R. (2013) 'Behavior of R . C . C . Beam With Rectangular Opening Strengthened By Cfrp and Gfrp Sheets', pp. 97–101.

Ezekiel Babatunde, O. *et al.* (2015) 'Potentials of kenaf fibre in bio-composite production: A review', *Jurnal Teknologi*, pp. 23–30. doi: 10.11113/jt.v77.6304.

Hafizah, N. A. K. *et al.* (2014) 'Kenaf Fiber Reinforced Polymer Composites for Strengthening RC Beams', *Journal of Advanced Concrete Technology*, 12(6), pp. 167–177. doi: 10.3151/jact.12.167.

Indexed, S., Manoharan, A. C. and Tripathi, R. K. (2017) 'ANALYSIS OF STEEL BEAMS WITH', 8(3), pp. 411–422.

Juliana, A. . and Paridah, M. . (2011) 'Evaluation of Basic Properties of Kenaf (Hibiscus Cannabinus L.) Particles as Raw Material for Particleboard', *18Th International Conference on Composite Materials*, 36, pp. 1–6.

Mansur, M. A. (2006) 'Design of Reinforced Concrete Beams with Web Openings', *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference*, (September), pp. 5–6. doi: 10.14359/720.

Meon, M. S. *et al.* (2012) 'Improving tensile properties of kenaf fibers treated with sodium

hydroxide', *Procedia Engineering*, 41(Iris), pp. 1587–1592. doi: 10.1016/j.proeng.2012.07.354.

Minas, T. and Bryant, T. (2015) 'Submitted by', *Pathology*, (April), pp. 84–86. doi: 10.13140/RG.2.1.3699.1522.

Mohamed, A. R., Shoukry, M. S. and Saeed, J. M. (2014) 'Prediction of the behavior of reinforced concrete deep beams with web openings using the finite ele ment method', *Alexandria Engineering Journal*. Faculty of Engineering, Alexandria University, 53(2), pp. 329–339. doi: 10.1016/j.aej.2014.03.001.

Mohsin, S. M. S. *et al.* (2016) 'Behaviour of reinforced concrete beams with kenaf and steel hybrid fibre', *ARPN Journal of Engineering and Applied Sciences*, 11(8), pp. 5385–5390.

Mohsin, S. S. (2012) 'Behaviour of fibre-reinforced concrete structures under seismic loading', (April).

Mondal, S. (2011) 'Strengthening and rehabilitation of reinforced concrete beams with opening.', *International Journal of …*, 2(1), pp. 127–138. doi: 10.6088/ijcser.00202010098.

Mostafa, M. and Uddin, N. (2015) 'Effect of Banana Fibers on the Compressive and Flexural Strength of Compressed Earth Blocks', *Buildings*, 5(1), pp. 282–296. doi: 10.3390/buildings5010282.

Nadzri, N. I. M., Jamaludin, S. B. and Noor, M. M. (2012) 'Development and properties of composite cement reinforced coconut fiber with the addition of fly ash', *8th Asian-Australasian Conference on Composite Materials 2012, ACCM 2012 - Composites: Enabling Tomorrow's Industry Today*, 1, pp. 296–301.

Nishino, T. *et al.* (2003) 'Kenaf reinforced biodegradable composite', *Composites Science and Technology*, 63(9), pp. 1281–1286. doi: 10.1016/S0266-3538(03)00099-X.

Osman, B. H. *et al.* (2017) 'Shear behavior of Reinforced Concrete (RC) beams with circular web openings without additional shear reinforcement', *KSCE Journal of Civil Engineering*, 21(1), pp. 296–306. doi: 10.1007/s12205-016-0387-7.

Paper, C. *et al.* (2015) 'a Study on Kenaf Fiber Reinforced Concrete Block With Quarry Dust As Fine Aggregate Replacement', (November).

Ramli, M., Kwan, W. H. and Abas, N. F. (2013) 'Strength and durability of coconut-fiber-reinforced concrete in aggressive environments', *Construction and Building Materials*. Elsevier Ltd, 38, pp. 554–566. doi: 10.1016/j.conbuildmat.2012.09.002.

Zdanowicz, Ł. and Wojdak, R. (2013) 'ZdanowiczL_StructuralAnalysis.pdf'.